

REMARKS

This is in response to the Office Action mailed on September 30, 2005, in which claim 17 was rejected under 35 U.S.C. § 112, second paragraph as being indefinite; claims 1, 2, 4, 8, 12-14, 16, 19, 20, 22, and 34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhu (“Thermal Magnetic Noise and Spectra in Spin Valve Heads,” 15 May 2002, J. Applied Phys., v. 91, no. 10, pp. 7273-7275) in view of Katine et al. (“Current-Driven Magnetization Reversal and Spin-Wave Excitations in Co/Cu/Co Pillars,” 3 April 2000, Phys. Rev. Lett. v. 84, no. 14, pp. 3149-3152); claims 3, 15, and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhu in view of Katine et al., and further in view of Heinonen et al. (U.S. Pat. No. 6,781,801); claims 6, 7, and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhu in view of Katine et al., and further in view of Dill et al. (U.S. Pat. No. 6,114,719); and claims 5, 9-11, and 21 were objected to as being allowable but dependent upon a rejected base claim, and claims 23-33 were allowed. With this Amendment, claim 17 is amended. Claims 1-34 remain pending in the present application.

Claim 17 was rejected under 35 U.S.C. § 112, second paragraph as being indefinite for reciting the limitation “the nonmagnetic metallic spacer layers” in line 2. With this Amendment, claim 17 is amended to refer to “the nonmagnetic metallic spacer layer” as introduced in claim 16. Thus, this rejection has been overcome and should accordingly be withdrawn.

Claims 1, 2, 4, 8, 12-14, 16, 19, 20, 22, and 34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhu in view of Katine et al. To establish *prima facie* obviousness there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. MPEP 2143.01; *In re Kotzab*, 217 F.3d 1365 (Fed. Cir. 2000). Zhu teaches a quantitative micromagnetic modeling analysis of thermally activated magnetic noise in spin valve heads. Zhu, p. 7273. The device modeled in Zhu was a spin valve head, and random magnetic fields were applied to the free layer. Zhu, section II, p. 7273. Thermal excitation, which was simulated by the applied random magnetic field, caused the spins in the free layer to deviate from their local equilibrium, resulting in noise in the free layer. Zhu, section III, pp. 7273-7274. Zhu concluded that this noise could be reduced by

reducing the flying height or increasing the medium signal flux by increasing medium area moment densities in the head. Zhu, section IV, p. 7275.

With regard to claim 1, the Office Action states that Zhu fails to teach “directing a spin polarized current perpendicular to a plane of the free layer, reference layer, and spacer layer, such that the current exerts a spin transfer torque on localized electron spins to reduce noise due to thermally activated spin waves.” With regard to claim 13, the Office Action states that Zhu fails to teach “a circuit for providing a current perpendicular to a plane of each of the layers in a direction that causes a reduction in thermally activated spin wave noise.” With regard to claim 34, the Office Action states that Zhu fails to teach “directing a spin polarized current through the CPP MR element in a direction which exerts a spin momentum transfer that reduces noise due to thermally activated spin waves, and detecting a voltage across the CPP MR element.” The Office Action attempted to supply the deficiencies of Zhu with regard to claims 1, 13, and 34 by turning to the disclosure of Katine et al. However, Katine et al. do not supply these deficiencies.

Katine et al. teach a thin film pillar including two Co layers of different thicknesses ($\text{Co } 1 < \text{Co } 2$) separated by a Cu spacer layer. Katine et al., FIG. 1. In low applied magnetic fields H , spin polarized electrons flowing from layer Co 1 to layer Co 2 switches the moment of layer Co 1 antiparallel to the moment of layer Co 2. In the high field regime, the spin-transfer effect does not produce a full reversal of the thin-layer moment, but results in precessing spin-wave excitation. Katine, p. 3149. However, the combination of the spin valve head of Zhu with the current-driven magnetization reversal and spin-wave excitation of Katine et al. results in a spin valve head having undesirable properties. In particular, if the random magnetic field applied to the modeled spin valve in Zhu is low (and the spin-polarized current of Katine et al. consequently reverses the magnetization direction of the free layer of the Zhu spin valve), the spin valve signal migrates from quiet to noisy or noisy to quiet, depending on the direction of the current. This uncontrolled change in the noise level of the device is contrary to the controlled reduction in thermally activated spin wave noise according to the present invention. In fact, the present application explicitly teaches away from this undesirable result, wherein “the selected magnitude of the spin momentum transfer torque is ... not

so large that spin transfer will induce a magnetization reversal of the free layer away from the direction set by the net bias field.” Page 13, lines 23-27.

On the other hand, if the random magnetic field applied to the spin valve in Zhu is high, the spin-polarized current of Katine et al. would result in precessing spin-wave excitation in the free layer. Katine et al., p. 3149. The precession of the spins that make up the magnetization of the free layer causes an increase in noise in the device. Page 4, lines 3-9 of the present application. This precession of the spin waves is precisely the phenomenon that the present invention is designed to reduce. While Katine et al. mentions that “the spin-transfer term can amplify or attenuate the precession amplitude,” this brief and oblique statement does not teach or fairly suggest the controlled approach of directing or providing a current perpendicular to the plane of the layers of a magnetoresistive element to reduce noise due to thermally activated spin waves, as required by claims 1, 13, and 34. Thus, the combination of Zhu with Katine et al. results in a spin valve device having *increased* noise, either due to the magnetization reversal of the free layer or the increased spin-wave excitation. If the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. MPEP 2143.01; *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Therefore, because there is no suggestion or motivation in Zhu, Katine et al., or in knowledge generally available to one of ordinary skill in the art to direct or provide a current perpendicular to the plane of the layers of a magnetoresistive element to reduce noise due to thermally activated spin waves, as required by claims 1, 13, and 34, these claims are allowable as originally submitted and favorable reconsideration is respectfully requested.

Claims 2, 4, 8, 12, 14, 16, 19, 20, and 22 were also rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhu in view of Katine et al. In addition, claims 3, 15, and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhu in view of Katine et al. and further in view of Heinonen et al., and claims 6, 7, and 18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhu in view of Katine et al. and further in view of Dill et al. As discussed above,

claims 1 and 13 are now in a condition for allowance. As such, these claims are allowable with their independent base claim. In addition, it is respectfully submitted that the combinations of features recited in claims 2-4, 6-8, and 12, 14-16, 18-20, and 22 are patentable on their own merits, although this does not need to be specifically addressed herein since any claim depending from a patentable independent claim is also patentable. See MPEP 2143.03, citing *In re Fine*, 837 F.2d 1071 (Fed. Cir. 1988).

Claims 5, 9-11, and 21 were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 5 and 9-11 depend from allowable claim 1 and claim 21 depends from allowable claim 13. Thus, the objections to claims 5, 9-11, and 21 are moot in light of the allowability of claims 1 and 13, and should accordingly be withdrawn.

The allowance of claims 23-33 is acknowledged.

CONCLUSION

In view of the foregoing, it is believed that all claims in the present application are in condition for allowance. Reconsideration and allowance of claims 1-34 are respectfully requested.

Respectfully submitted,

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